High-Speed, Rail-to-Rail I/O, Single CMOS Operational Amplifier

■ FEATURES

- Operating Voltage: 2.7V to 5.5V
- High speed SR=9V/μs. typ.(at V_{DD}= 5V)
  GBW=5MHz typ.
- Rail-to-Rail Input/Output
- Low input bias current I_B=1pA typ.
- Unity gain stable
- Enhanced RF noise Immunity
- Package outline SOT−23−5, SC88A
- CMOS process
- Wide temperature range Ta=−40°C to 125°C

■APPLICATIONS

- Current sensors / Sensor amplifiers
- Photodiode amplifiers
- ADC front ends
- ASIC input or output amplifiers
- Battery-powered instruments

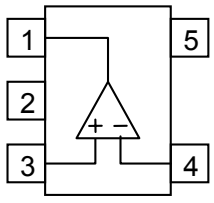
■ GENERAL DESCRIPTION

The NJU7046 is a single rail to rail input/output operational amplifier featuring high speed, low input bias current and wide temperature range.

High-speed characteristics of slew rate(SR=9V/us) and bandwidth (GBW=5MHz), low input bias current (I_B=1pA typ.) and wide temperature range(Ta=−40°C to 125°C) makes NJU7046 especially suitable for sensors and filters application for industrial, buffers of input and output for ADC, DAC, ASIC and other wide output swing devices.

In addition to the NJU7046F3 is available in the ultra-small SC88A package. This package saves space on print circuit boards and enables the design of Battery-powered instruments.

■PIN CONFIGURATION



PIN FUNCTION
1: OUTPUT
2: V_{SS}
3: +INPUT
4: -INPUT
5: V_{DD}

SOT−23−5 , SC88A
(Top View)

■PACKAGE OUTLINE

NJU7046F
(SOT−23−5)

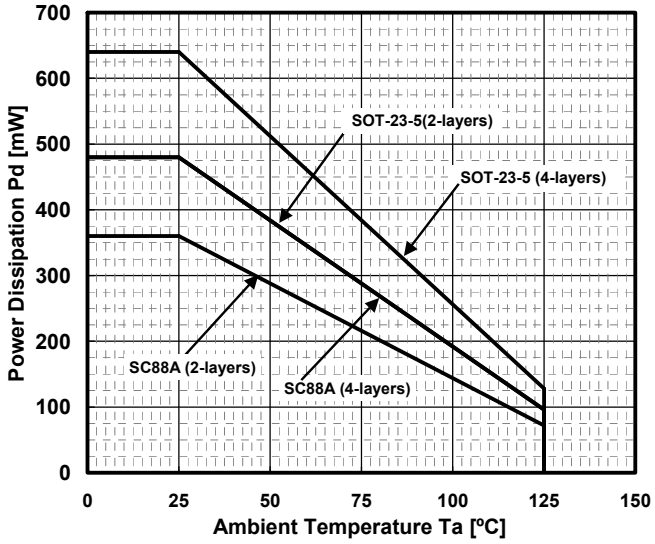
NJU7046F3
(SC88A)

■ABSOLUTE MAXIMUM RATINGS(Ta=25°C unless otherwise noted.)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	+7	V
Input Common Mode Voltage	V_{ICM}	V_{SS}-0.3 to V_{DD}+0.3	V
Differential Input Voltage	V_{ID}	±7 (Note1)	V
Power Dissipation	P_D	[SC88A] 360 (Note2), 480 (Note3)	mW
		[SOT−23−5] 480 (Note2), 640 (Note3)	
Operating Temperature Range	T_{opr}	-40 to +125	°C
Storage Temperature Range	T_{stg}	-55 to +150	°C

(Note1) For supply voltage less than +7V, the absolute maximum rating is equal to the supply voltage.
(Note2) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2layers, FR-4) mounting.
(Note3) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 4layers, FR-4) mounting.
(Note4) Do not exceed "Power dissipation: P_D" in which power dissipation in IC is shown by the absolute maximum rating.
See Figure "Power Dissipation Curve" when ambient temperature is over 25°C.

Figure1.Power Dissipation Derating Curve



■RECOMMENDED OPERATING CONDITION (Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	2.7 to 5.5	V

■ELECTRICAL CHARACTERISTICS

DC CHARACTER (V_{DD}=5V, V_{SS}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	Icc	No Signal	-	1.4	2.2	mA
Input Offset Voltage	V_{IO}	V_{ICM}=5V	-	0.9	5	mV
		V_{ICM}=2.5V	-	0.9	5	mV
		V_{ICM}=0V	-	0.9	5	mV
Input Offset Voltage Drift	ΔVio/ΔT		-	2	-	μV/°C
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open Loop Gain	A_V	Vout=1.5V to 3.5V, R_L=10kΩ to 2.5V	90	110	-	dB
Common Mode Rejection Ratio	CMR	V_{ICM}=0V to 5V	60	80	-	dB
Supply Voltage Rejection Ratio	SVR	V_{DD}=2.7V to 5.5V, V_{ICM}=0V	65	90	-	dB
Maximum Output Voltage	V_{OH}	R_L=10kΩ to 2.5V	4.95	4.99	-	V
		R_L=600Ω to 2.5V	4.88	4.93	-	V
	V_{OL}	R_L=10kΩ to 2.5V	-	0.01	0.05	V
		R_L=600Ω to 2.5V	-	0.07	0.12	V
Common Mode Input Voltage Range	V_{ICM}	CMR≥60dB	0	-	5	V

AC CHARACTER (V_{DD}=5V, V_{SS}=0V, V_{ICM}=2.5V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	5	-	MHz
Phase Margin	φ_M	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	70	-	deg
Gain Margin	G_M	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	16	-	dB
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	20	-	nV/√Hz
Slew Rate	SR	G_V=0dB, R_L=10kΩ, C_L=20pF, V_{IN}=$2V_{PP}$	5	9	-	V/μs
Total Harmonic Distortion	THD	G_V=0dB, R_L=10kΩ, f=1kHz, V_O=1Vrms	-	0.01	-	%

■ELECTRICAL CHARACTERISTICS

DC CHARACTER (V_{DD}=2.7V, V_{SS}=0V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	Icc	No Signal	-	1.2	2	mA
Input Offset Voltage	V_{IO}	V_{ICM}=2.7V	-	0.9	5	mV
		V_{ICM}=1.35V	-	0.9	5	mV
		V_{ICM}=0V	-	0.9	5	mV
Input Offset Voltage Drift	ΔVio/ΔT		-	2	-	μV/°C
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{IO}		-	1	-	pA
Open Loop Gain	A_V	Vout=0.35V to 2.35V, R_L=10kΩ to 1.35V	90	110	-	dB
Common Mode Rejection Ratio	CMR	V_{ICM}=0V to 2.7V	55	75	-	dB
Maximum Output Voltage	V_{OH}	R_L=10kΩ to 1.35V	2.65	2.69	-	V
		R_L=600Ω to 1.35V	2.6	2.64	-	V
	V_{OL}	R_L=10kΩ to 1.35V	-	0.01	0.05	V
		R_L=600Ω to 1.35V	-	0.05	0.1	V
Common Mode Input Voltage Range	V_{ICM}	CMR≥55dB	0	-	2.7	V

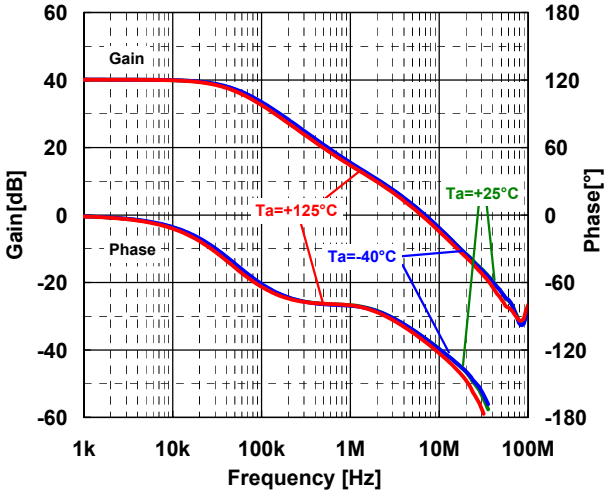
AC CHARACTER (V_{DD}=2.7V, V_{SS}=0V, V_{ICM}=1.35V, Ta=25˚C, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Gain Bandwidth Product	GBW	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	5	-	MHz
Phase Margin	φ_M	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	65	-	deg
Gain Margin	G_M	G_V=40dB, R_F=100kΩ, R_L=10kΩ, C_L=20pF	-	18	-	dB
Equivalent Input Noise Voltage	V_{NI}	f=1kHz	-	20	-	nV/√Hz
Slew Rate	SR	G_V=0dB, R_L=10kΩ, C_L=20pF, V_{IN}=2V_{PP}	3.5	7	-	V/μs
Total Harmonic Distortion	THD	G_V=0dB, R_L=10kΩ, f=1kHz, V_O=1Vrms	-	0.02	-	%

■TYPICAL CHARACTERISTICS

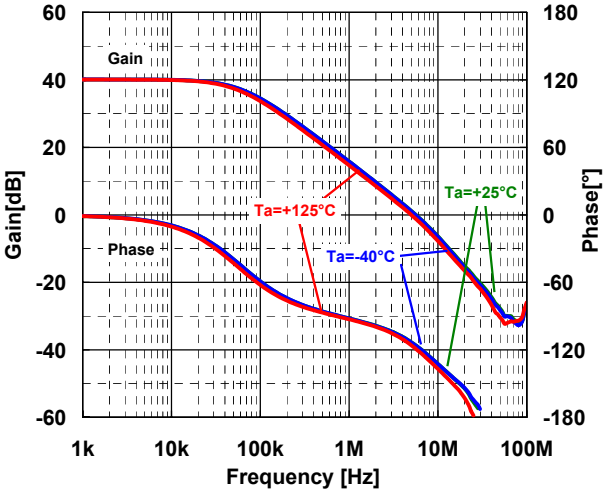
Gain/Phase vs. Frequency (Temperature)

G_V=40dB, V_{DD}=5V, R_F=100kΩ, R_G=1kΩ, R_L=10kΩ, C_L=20pF



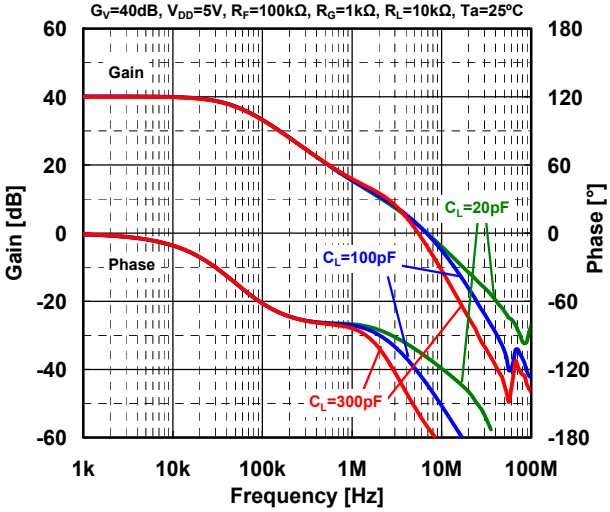
Gain/Phase vs. Frequency (Temperature)

G_V=40dB, V_{DD}=2.7V, R_F=100kΩ, R_G=1kΩ, R_L=10kΩ, C_L=20pF



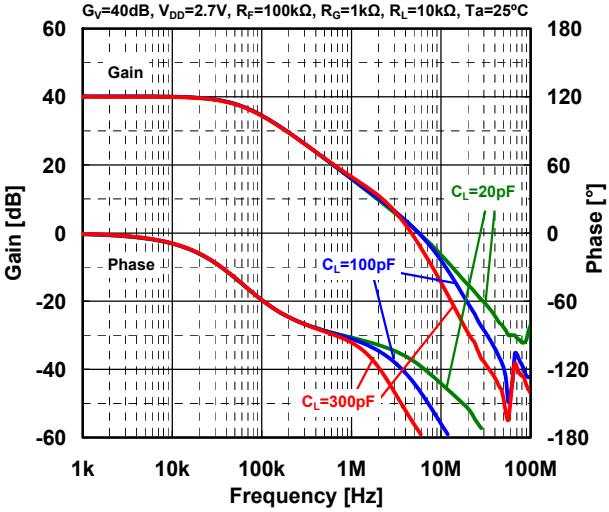
Gain/Phase vs. Frequency (Load Capacitance)

G_V=40dB, V_{DD}=5V, R_F=100kΩ, R_G=1kΩ, R_L=10kΩ, Ta=25°C



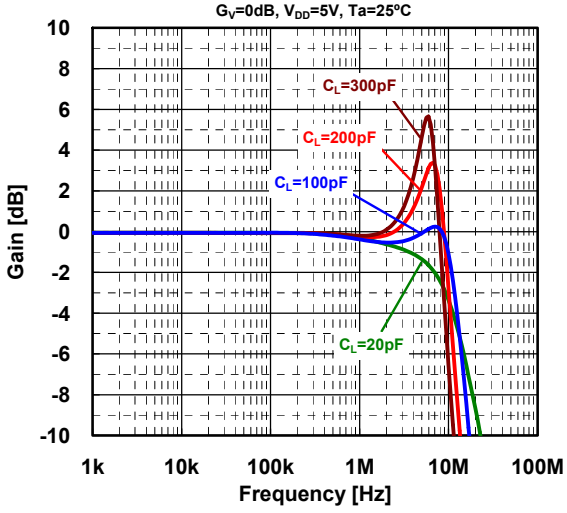
Gain/Phase vs. Frequency (Load Capacitance)

G_V=40dB, V_{DD}=2.7V, R_F=100kΩ, R_G=1kΩ, R_L=10kΩ, Ta=25°C



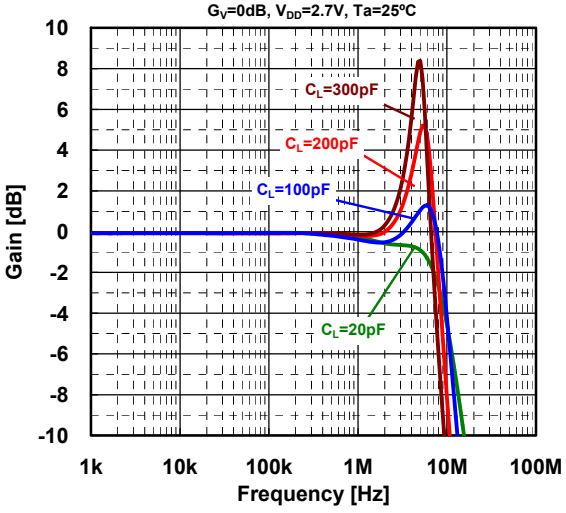
Unity Gain Frequency Response (Load Capacitance)

G_V=0dB, V_{DD}=5V, Ta=25°C

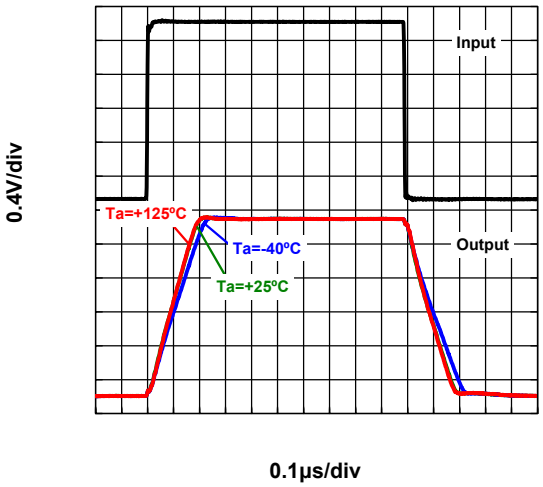


Unity Gain Frequency Response (Load Capacitance)

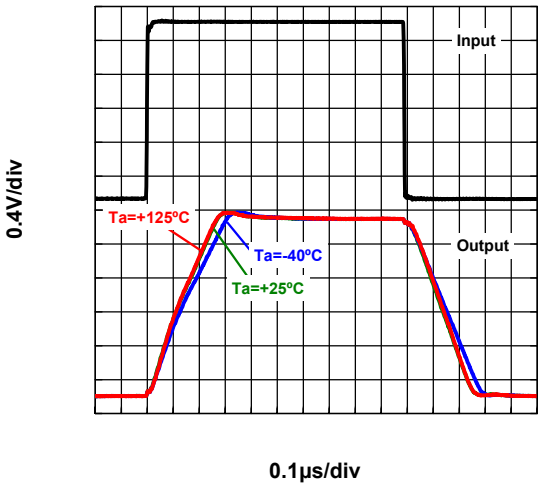
G_V=0dB, V_{DD}=2.7V, Ta=25°C



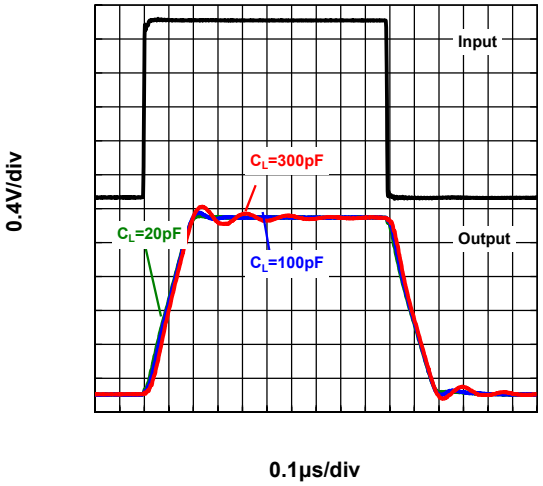
Transient Response (Temperature)
V_{DD}=5V, V_{IN}=2Vpp, R_L=10kΩ, C_L=20pF



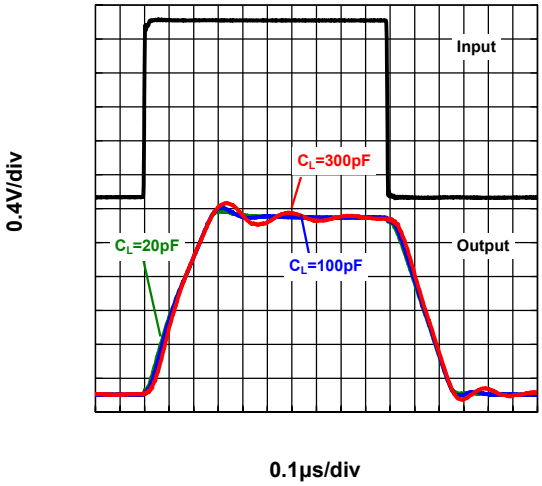
Transient Response (Temperature)
V_{DD}=2.7V, V_{IN}=2Vpp, R_L=10kΩ, C_L=20pF



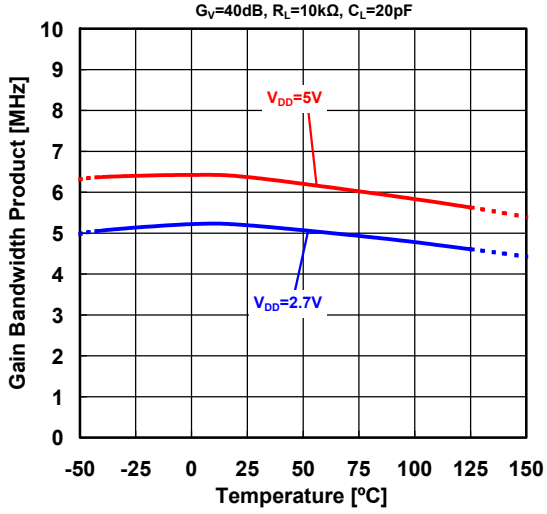
Transient Response (Load Capacitance)
V_{DD}=5V, V_{IN}=2Vpp, R_L=10kΩ, Ta=25°C



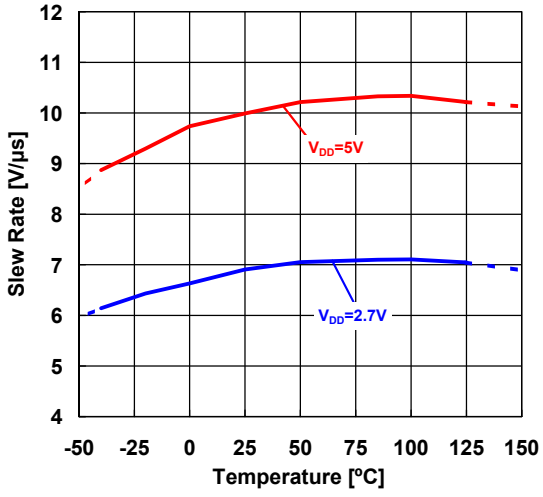
Transient Response (Load Capacitance)
V_{DD}=2.7V, V_{IN}=2Vpp, R_L=10kΩ, Ta=25°C



Gain Bandwidth Product vs. Temperature
G_V=40dB, R_L=10kΩ, C_L=20pF

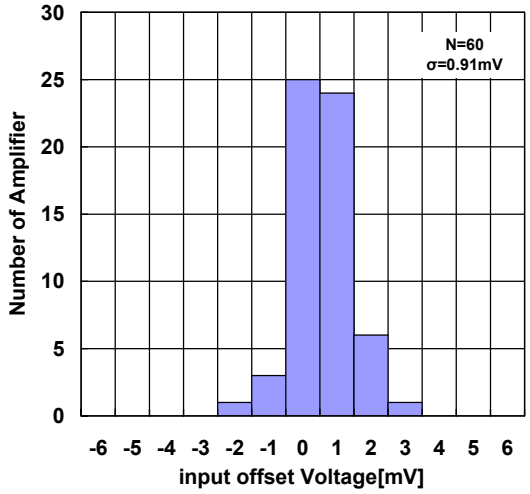


Slew Rate vs. Temperature (Supply Voltage)
G_V=0dB, V_{IN}=1Vpp, R_L=10kΩ, C_L=20pF



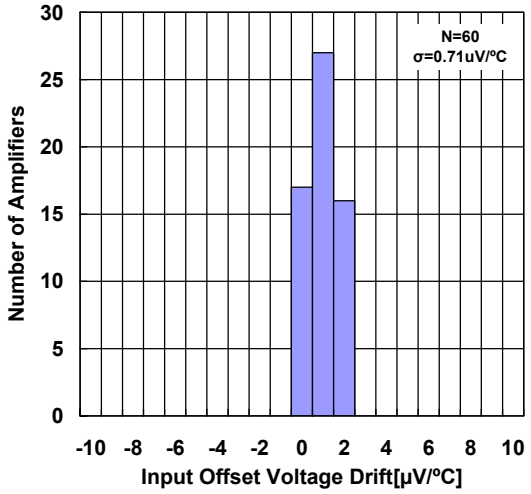
Input Offset Voltage Distribution

V_{DD}=5V, V_{ICM}=2.5V, Ta=25ºC



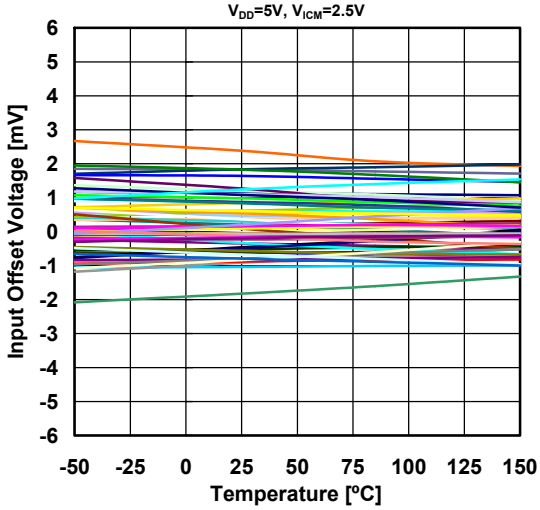
Input Offset Voltage Drift Distribution

V_{DD}=5V, V_{ICM}=2.5V, Ta=-40ºC to 125ºC



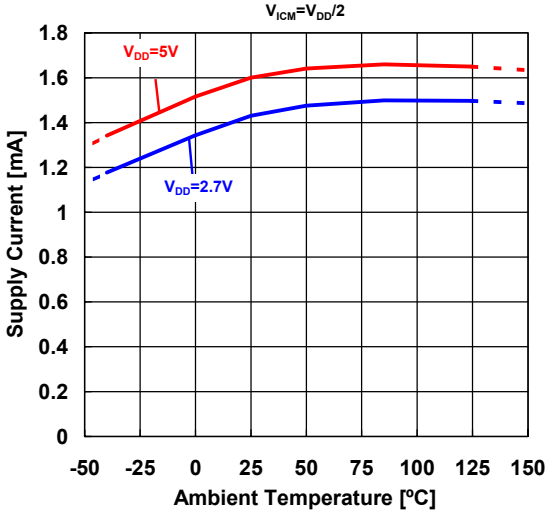
Input Offset Voltage vs. Temperature

V_{DD}=5V, V_{ICM}=2.5V



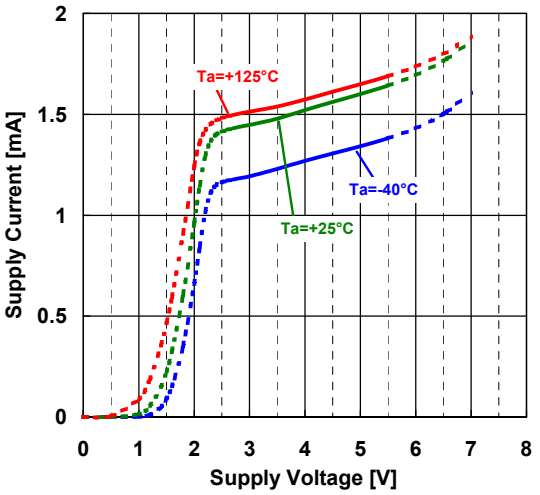
Supply Current vs. Temperature

V_{ICM}=V_{DD}/2



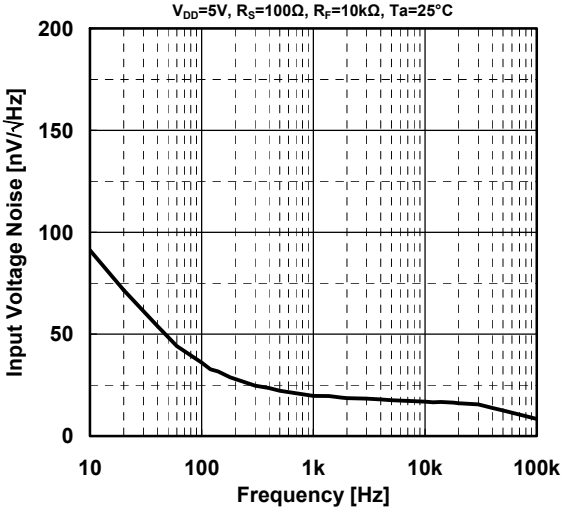
Supply Current vs. Supply Voltage (Temperature)

V_{ICM}=V_{DD}/2

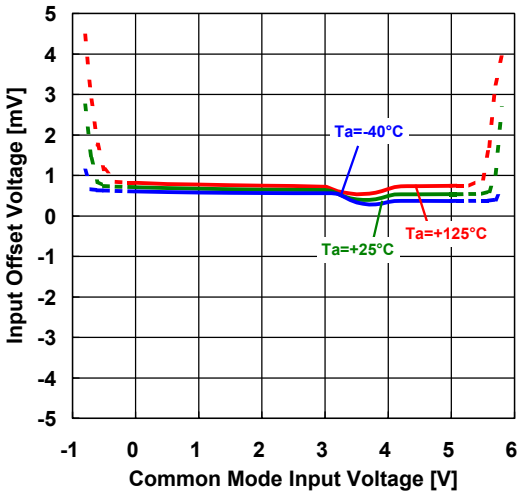


Input Voltage Noise vs. Frequency

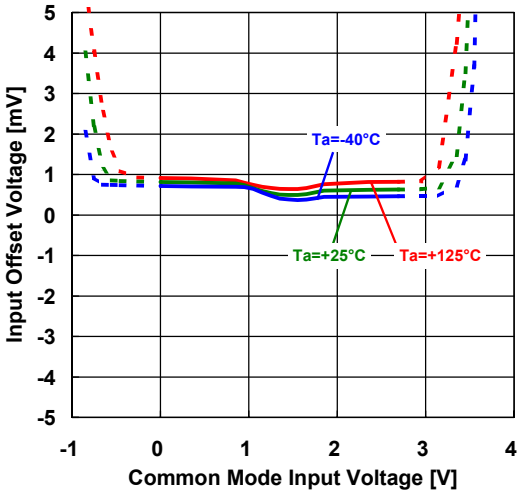
V_{DD}=5V, R_S=100Ω, R_F=10kΩ, Ta=25°C



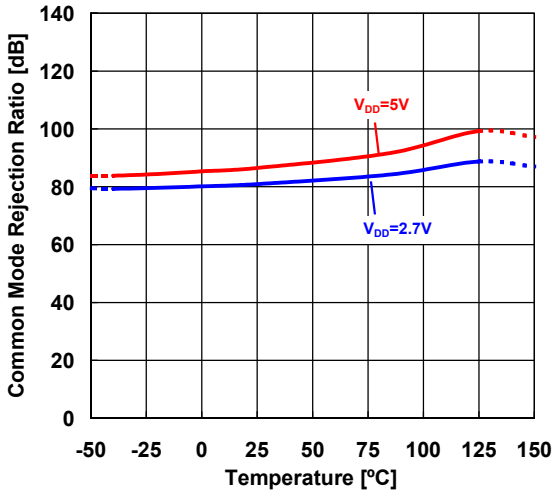
Input Offset Voltage vs. Common Mode Input Voltage (Temperature)
V_{DD}=5V, V_{ICM}=V_{DD}/2



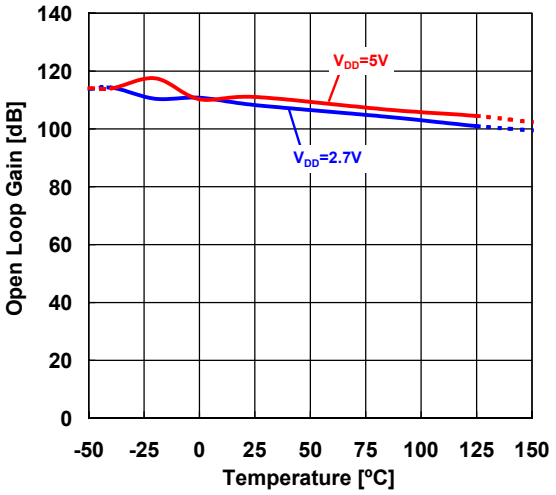
Input Offset Voltage vs. Common Mode Input Voltage (Temperature)
V_{DD}=2.7V, V_{ICM}=V_{DD}/2



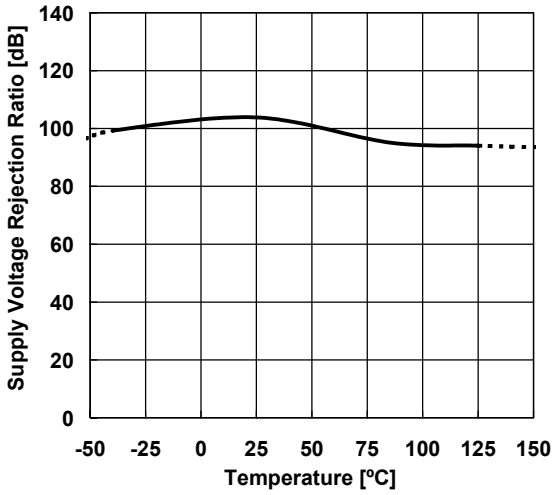
CMR vs. Temperature (Supply Voltage)
V_{ICM}=V_{SS} to V_{DD}



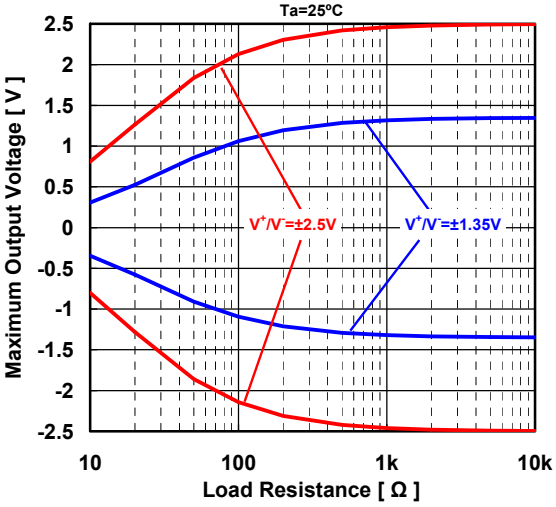
Open Loop Gain vs. Temperature (Supply Voltage)
V_O=V_{DD}/2 ± 1V

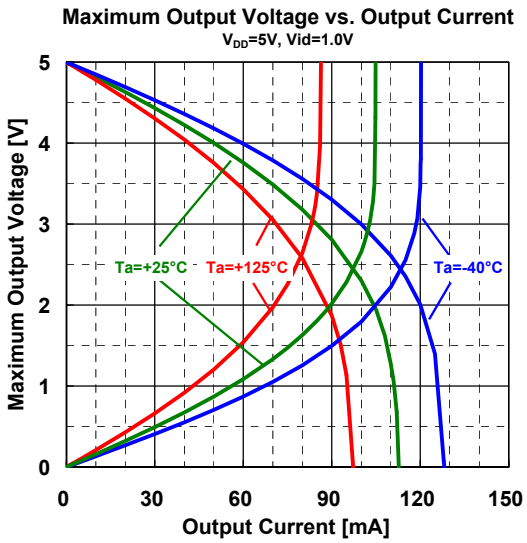


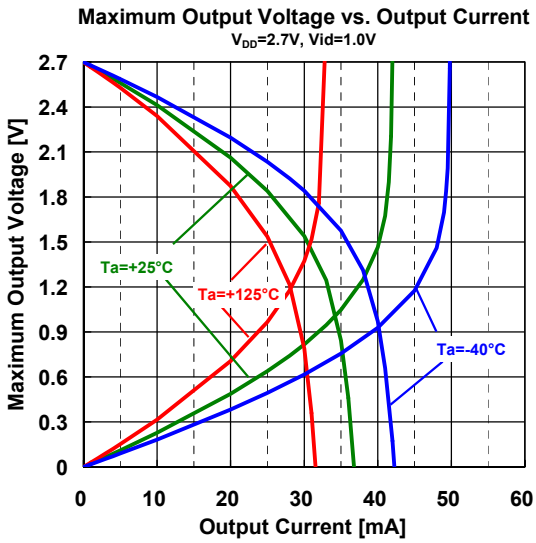
SVR vs. Temperature
V_{DD}=2.7V to 5.5V



Maximum Output Voltage vs. Load Resistance
Ta=25ºC

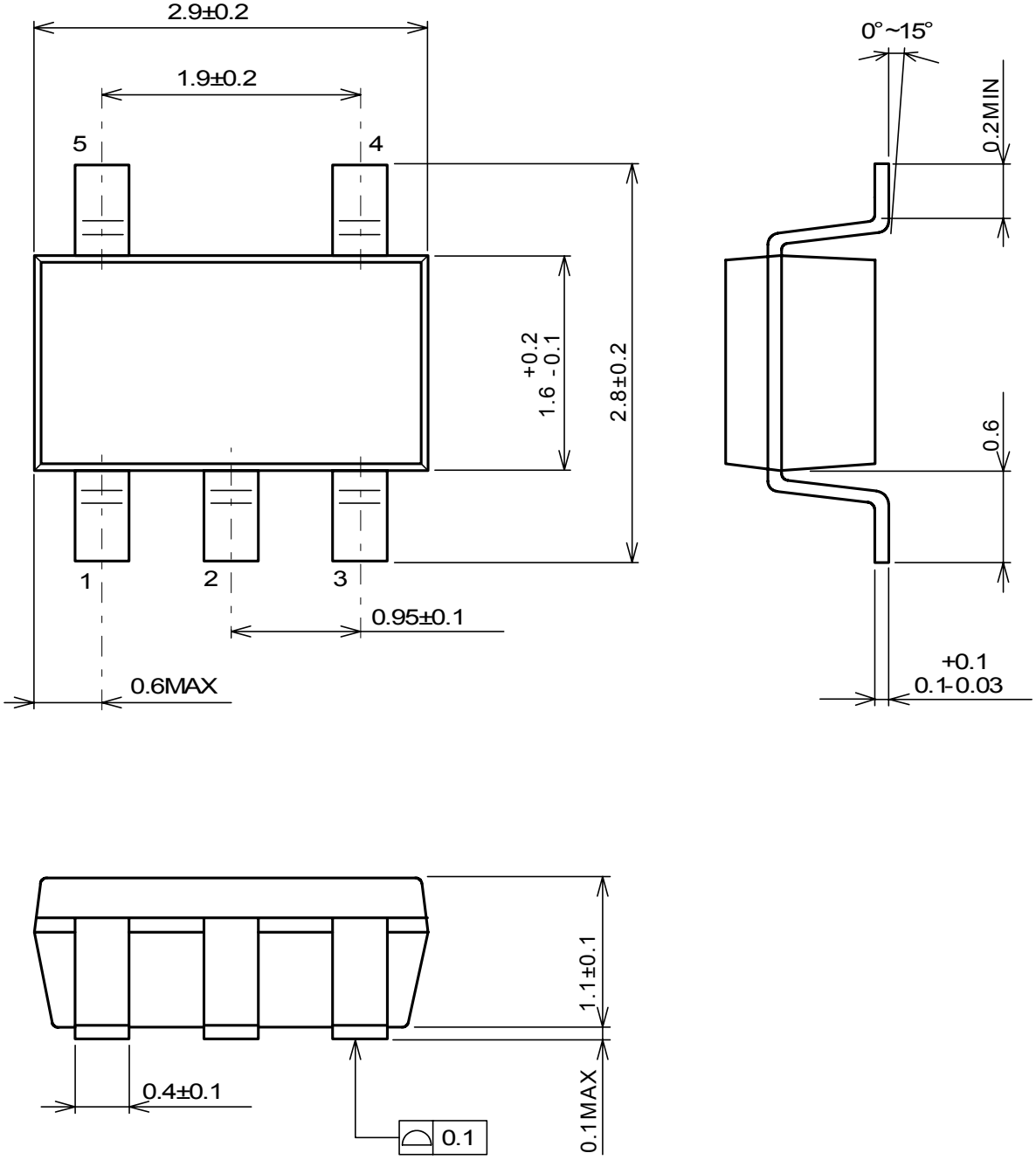



Maximum Output Voltage vs. Output Current
V_{DD}=5V, Vid=1.0V
Maximum Output Voltage [V]
Output Current [mA]
0
1
2
3
4
5
0
30
60
90
120
150
Ta=+25°C
Ta=+125°C
Ta=-40°C


Maximum Output Voltage vs. Output Current
V_{DD}=2.7V, Vid=1.0V
Maximum Output Voltage [V]
Output Current [mA]
0
0.3
0.6
0.9
1.2
1.5
1.8
2.1
2.4
2.7
0
10
20
30
40
50
60
Ta=+25°C
Ta=+125°C
Ta=-40°C

■ **PACKAGE DIMENSIONS**

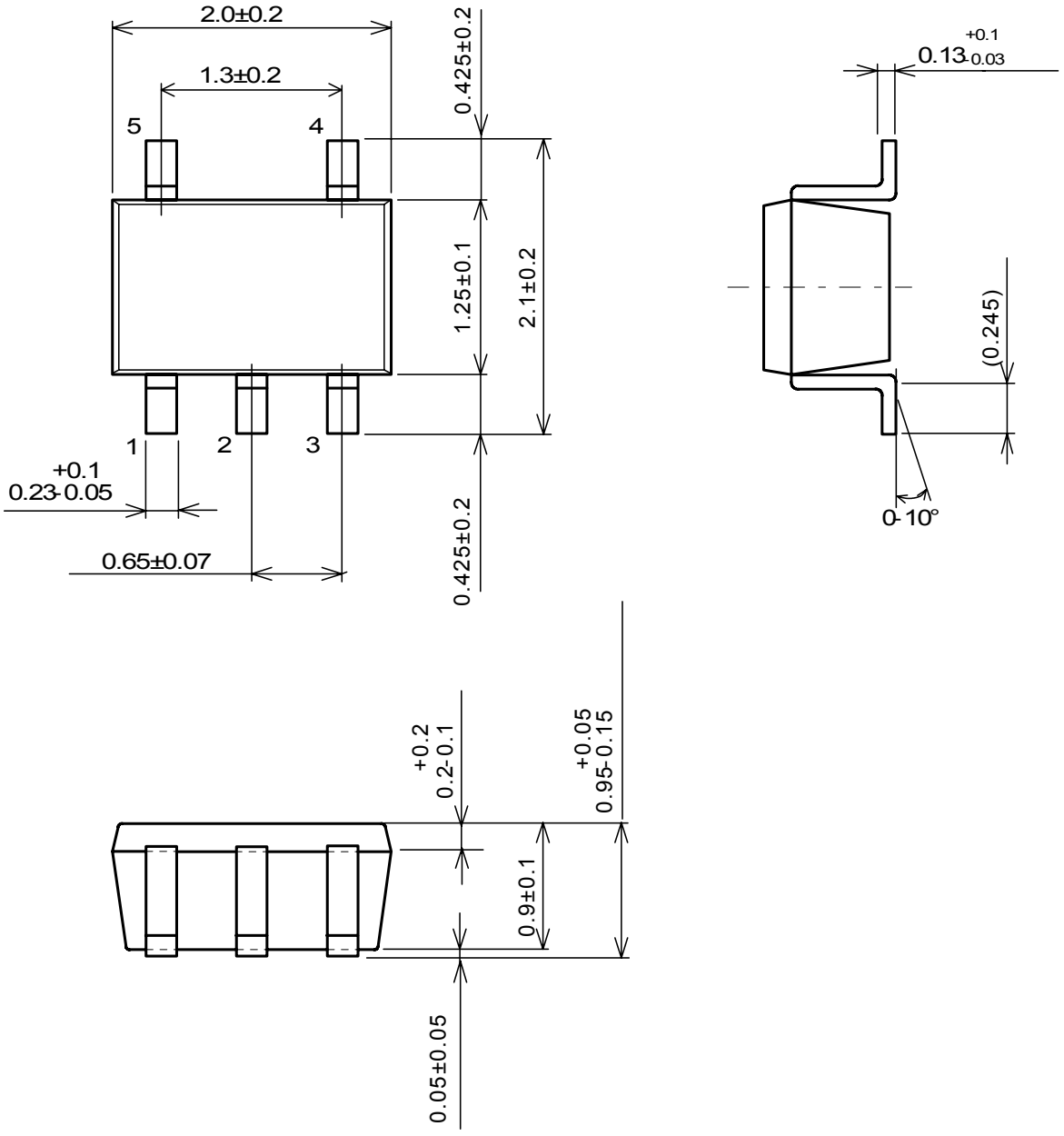
SOT-23-5



UNIT: mm

■ **PACKAGE DIMENSIONS**

SC88A



UNIT: mm

■ MEMO